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(54) **Combination structure of bicycle frame and motor hub**

Kombinationsstruktur aus Fahrradrahmen und Motornabe

Structure de combinaison de cadre de bicyclette et moyeu à moteur

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a combination structure of frame and motor hub, and more particularly, to a combination structure of frame and motor hub adapted for an electric bicycle.

2. Description of Related Art

[0002] Conventionally, the wheel axle of an electric bicycle is provided with a motor hub at the center of the axle for driving forward the electric bicycle, where both sides of the motor hub are pivotally arranged in between a fork assembly and are fastened and secured thereto with nuts.

[0003] Document EP1820727 discloses a similar structure having the motor secured between two fork legs to the bicycle frame.

[0004] However, when assembly of the motor hub or replacement thereof, complex steps are required to manually detach the nuts from both sides of the motor hub so as to replace or maintain the same. Namely, when maintenance staff want to assemble or replace the motor hub, the nuts at both sides of the hub need to be tightly fastened manually so as to attach the hub; or on the other hand, the nuts need to be manually unfastened so as to detach the same from the bicycle frame. Such manual work is rather inconvenient, and the fastening or unfastening of the nuts is indeed time and labor consuming.

[0005] Further, the frame-fastening holes located at two sides of the conventional motor hub have downward U-shaped openings, where nuts are tightened toward the frame and the axle so as to secure the same. However, when disassembling the motor hub, if the axle of the motor hub escapes suddenly from the U-shaped openings, the motor hub may fall and be damaged or even hurt people. This will add inconvenience to maintenance staff.

[0006] In view of the above, an innovative combination structure of bicycle frame and motor hub has been developed, through persistent experiments, so as to improve convenience and safety during maintenance or assembly of the electric bicycle.

SUMMARY OF THE INVENTION

[0007] An object of the present invention is to provide a combination structure of bicycle frame and motor hub, comprising a bicycle frame, a motor hub, and an elongated axle. The bicycle frame includes a first fork and a second fork which are oppositely arranged, wherein the first fork is provided with a through hole, while the second fork is recessed with an internal thread hole corresponding axially to the through hole, and the first fork is provided, at its inner side adjacent to the through hole, with a

positioning groove. Further, the motor hub is provided, at its center, with a sleeve having an end, related to a positioning end, such that the positioning end can be engaged with and stopped at the positioning groove of the first fork, and that the sleeve cannot rotate. The elongated axle has a head end and a tail end, wherein the tail end has an external thread. The elongated axle can pass through the through hole of the first fork and the sleeve of the motor hub, and then the external thread of the tail end is engaged correspondingly and fastened into the internal thread hole of the second fork.

[0008] By means of the above-mentioned structure, the present invention provides a combination structure of bicycle frame and motor hub such that one can extend, from one side of the bicycle frame, the elongated axle through the through hole of the bicycle frame and the motor hub, and then with one hand, the tail end of the elongated axle can be fastened into the internal thread hole of the bicycle frame. This will facilitate assembly of the components of the motor hub and the bicycle frame. Besides, when screwing or unscrewing the elongated axle, since the elongated axle has passed through the through hole and the internal thread hole opposing each other at the bicycle frame, the motor hub will not fall accidentally, and convenience can be assured for maintenance staff during proceeding of maintenance work.

[0009] The combination structure of bicycle frame and motor hub, according to a preferred embodiment of the present invention, further comprises a sprocket assembly including a coupling sleeve, a flywheel chain disk, and an end cap. The coupling sleeve is arranged, coaxially, to the motor hub. The flywheel chain disk is provided outside of the coupling sleeve such that the flywheel chain disk can rotate synchronously therewith. The flywheel chain disk is provided, radially, with at least one flywheel. This makes the electric bicycle have at least one or more stages of speed change during pedaling. According to a preferred embodiment of the present invention, a plurality of axially-extended ribs are provided at external circumference of the coupling sleeve. A plurality of slots are provided at internal circumferential wall of the flywheel chain disk where the flywheel chain disk and the coupling sleeve rotate synchronously, in such a manner that the plural slots are correspondingly engaged with the plural ribs. In addition, an end cap may be arranged, coaxially, neighboring to the coupling sleeve so as to position the same.

[0010] Preferably, the positioning end of the sleeve is provided with at least one engaging portion, so that the sleeve can be correspondingly engaged with and stopped at the positioning groove of the bicycle frame through the at least one engaging portion, and that the sleeve will not rotate relative to the bicycle frame. According to preferred embodiments of the present invention, the positioning groove and the at least one engaging portion may be of various shapes so long as they are engaged and stopped with each other, and no rotation relative to each other, can be achieved. For instance, the

positioning groove may be rectangular, and the engaging portions may be designed to be of two parallel engaging surfaces such that the positioning groove and the engaging portions can be engaged and stopped with each other. Of course, the positioning groove can also be other shapes, such as square, hexagonal, or octagonal, etc. Therefore, the engaging portions may be of similar shapes as that of the positioning groove for correspondingly engaging and stopping with the positioning groove in order to avoid rotation of the same. Or even if there is only one engaging surface for the engaging portion, that is sufficient for engaging and stopping with only one side of the positioning groove.

[0011] Further, according to a preferred embodiment of the present invention, the sleeve is provided, around the whole middle section thereof, with straight slots such that the stator assembly of the motor hub can be engaged with and fixed to the sleeve and be stopped from rotation relative to the bicycle frame.

[0012] The motor hub preferably includes a stator assembly, a left cover, a right cover, and a plurality of rotor elements. The plural rotor elements are provided around an inner wall of the left cover or of the right cover. The stator assembly can be engaged with and fixed to the sleeve so as to correspond radially to the plural rotor elements. The left cover and the right cover, after having been in alignment with each other and through bearings, are assembled on the stator assembly. As a result, the left cover and the right cover can rotate relative to the stator assembly.

[0013] In the present invention, the elongated axle may be of solid form, or of hollow form so as to reduce the weight of the motor hub. The head end of the elongated axle may be of internal hexagonal head or of external hexagonal head, or other equivalent structure so long as the fastening and tightening purpose can be achieved, so that the bicycle frame, the motor hub and the sprocket assembly can be fastened.

[0014] The above and the following descriptions are for the purpose of exemplification, and for further describing the claims as appended. Other objects, advantages, and novel features of the present invention will become more apparent from the following detailed description of a preferred embodiment, which is described by way of example only in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

FIG. 1 is a perspective view illustrating a combination structure of bicycle frame and motor hub according to the present invention;

FIG. 2 is an exploded view illustrating the combination structure of bicycle frame and motor hub according to the present invention; and

FIG. 3 is a cross-sectional view illustrating the com-

bination structure of bicycle frame and motor hub according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] Referring to FIG. 1, a perspective view illustrating a combination structure of bicycle frame and motor hub according to the present invention, a motor hub 2 is mounted on the rear wheel of a bicycle frame 1, where a sprocket assembly 4 is positioned beside the motor hub 2.

[0017] Now referring to FIG. 2, an exploded view illustrating the combination structure of bicycle frame and motor hub, and to FIG. 3, a cross-sectional view illustrating the combination structure of bicycle frame and motor hub, the bicycle frame 1 includes a first fork 11 and a second fork 12 which are oppositely arranged, wherein the first fork 11 is provided with a through hole 110, while the second fork 12 is recessed with an internal thread hole 121 corresponding axially to the through hole 110, and the first fork 11 is provided, at its inner side adjacent to the through hole 110, with a positioning groove 111.

[0018] As shown in FIG. 2, the motor hub 2, according to the present invention, includes a sleeve 21, a stator assembly 22, a left cover 23, a right cover 25, and a plurality of rotor elements 24. The sleeve 21 passes through the center of the motor hub 2, where an end of the sleeve 21 relates to a positioning end 211 having two engaging portions 210 at two sides thereof such that the sleeve 21 can be engaged with and stopped at the positioning groove 111 of the first fork 11 by means of the engaging portions 210. In the present invention, the positioning groove 111 of the first fork 11 relates to a rectangular groove; whereas the engaging portions 210 of the sleeve 21 relate to two stopping surfaces parallel with each other, so that the engaging portions 210 will not rotate relative to the positioning groove 111 when they engage with the same.

[0019] Further, the sleeve 21 is provided, around the whole middle section thereof, with straight slots 212; and a corresponding structure is also provided inside a stator hole 220 of the stator assembly 22 such that the stator assembly 22 can be engaged with and fixed to the sleeve 21 through the slots 212 and be stopped from rotation.

[0020] According to the present invention, the plural rotor elements 24 are provided around an inner wall of the left cover 23. As shown in FIG. 3, the left cover 23 and the right cover 25, after having been in alignment with each other and through two bearings 221, 222, are assembled on the stator assembly 22. As a result, the left cover 23 and the right cover 25 can rotate relative to the stator assembly 22, and rotate together with the sprocket assembly 4 and the rear wheel.

[0021] Further, as shown in FIG. 2, the sprocket assembly 4 includes a coupling sleeve 41, a flywheel chain disk 42, and an end cap 43, wherein the left end of the coupling sleeve 41 is attached to the right cover 25 of

the motor hub 2. A plurality of axially-extended ribs 411 are provided at external circumference of the coupling sleeve 41 such that the axially-extended ribs 411 correspond to a plurality of slots 421 provided at internal circumferential wall of the flywheel chain disk 42 where the ribs 411 and the slots 421 are engaged with each other and rotate synchronously. The flywheel chain disk 42 is provided, radially, with one or more flywheels in different diameters.

[0022] As shown in FIG. 3, the end cap 43 is arranged at one end of the sleeve 21, and, coaxially arranged at the right end of the coupling sleeve 41 so as to fix the sleeve 21 in position. Besides, the end cap 43 keeps away from the second fork 12 a certain distance so as to prevent the coupling sleeve 41 from being worn by the second fork 12 during rotation thereof.

[0023] Still further, as shown in FIG. 2, an elongated axle 3 has a head end 31 and a tail end 32, wherein the head end 31 has a hexagonal head and the tail end 32 has an external thread 320. Therefore, when in assembly, the elongated axle 3 can pass through the through hole 110 of the first fork 11 and the sleeve 21 of the motor hub 2, and then the external thread 320 of the tail end 32 is engaged correspondingly and fastened into the internal thread hole 121 of the second fork 12. This makes the assembly work can be completed by one hand from one side. In addition, when screwing the internal hexagonal head of the elongated axle 3, since the engaging portion 210 of the sleeve 21 has been engaged with and stopped at the positioning groove 111 of the first fork 11, the motor hub 2 will not rotate together, and as such, the assembly work becomes convenient. In the present invention, the elongated axle 3 is hollow, so that the motor hub 2 achieves the purpose of lightweight.

[0024] According to the present invention, the positioning groove 111 may be of other shape, for instance, square, hexagonal, or octagonal, etc. Likewise, the engaging portions 210, which correspond to the positioning groove 111, can be of similar shape such that the sleeve 21 will be stopped from rotation. This positioning function in a certain direction for the bicycle frame can also be achieved if the sleeve 21 has only one engaging portion 210 engaged with one side of the sleeve 21.

[0025] Given the above, it is understood that, according to the present invention, one can extend the elongated axle 3 through the through hole 110 of the bicycle frame 1 and the sleeve 21 of the motor hub 2, and then with one hand, the tail end 32 of the elongated axle 3 can be fastened into the internal thread hole 121 of the bicycle frame 1. This will facilitate assembly of the components of the motor hub 2 and the bicycle frame 1. Besides, when screwing or unscrewing the elongated axle 3, since the elongated axle 3 has passed through the through hole 110 and the internal thread hole 121 opposing each other at the bicycle frame 1, and since the lower edge of the elongated axle 3 is held by the through hole 110 and the internal thread hole 121, the elongated axle 3, during disassembly thereof, can be prevented from escaping

out suddenly and thus the motor hub 2 will neither fall nor people get hurt, and thus safety can be assured.

[0026] Although the present invention has been explained in relation to its preferred embodiments, it is to be understood that many other possible modifications and variations can be made without departing from the scope of the invention as hereinafter claimed.

10 Claims

1. A combination structure of bicycle frame and motor hub, comprising:

a bicycle frame (1), including a first fork (11) and a second fork (12) which are oppositely arranged, wherein the first fork (11) is provided with a through hole (110), while the second fork (12) is recessed with an internal thread hole (121) corresponding axially to the through hole, and the first fork (11) is provided, at its inner side adjacent to the through hole (110), with a positioning groove (111);

a motor hub (2), being provided, at its center, with a sleeve (21) having an end, related to a positioning end, such that the positioning end (211) can be engaged with and stopped at the positioning groove (111) of the first fork; and an elongated axle (3) having a head end (31) and a tail end (32), wherein the tail end has an external thread; the elongated axle (3) can pass through the through hole (110) of the first fork and the sleeve (21) of the motor hub (2), and wherein the external thread of the tail end (32) is engaged correspondingly and fastened into the internal thread hole (121) of the second fork.

2. The combination structure of bicycle frame and motor hub as claimed in claim 1, further comprising a sprocket assembly (4) including a coupling sleeve (41) and a flywheel chain disk (42), wherein the coupling sleeve is arranged, coaxially, to the motor hub (2), and the flywheel chain disk is provided outside of the coupling sleeve such that the flywheel chain disk can rotate synchronously therewith, and the flywheel chain disk (42) is provided, radially, with at least one flywheel.

3. The combination structure of bicycle frame and motor hub as claimed in claim 2, wherein the sprocket assembly (4) further includes an end cap arranged, coaxially, neighboring to the coupling sleeve (41).

4. The combination structure of bicycle frame and motor hub as claimed in claim 2 or 3, wherein a plurality of axially-extended ribs (411) are provided at external circumference of the coupling sleeve (41), and a plurality of slots (421) are provided at internal cir-

cumferential wall of the flywheel chain disk (42) such that the flywheel chain disk and the coupling sleeve can rotate synchronously in such a manner that the plural slots are correspondingly engaged with the plural ribs.

5. The combination structure of bicycle frame and motor hub as claimed in any preceding claim, wherein the positioning end of the sleeve (21) is provided with at least one engaging portion, so that the sleeve can be correspondingly engaged with and stopped at the positioning groove (111) of the bicycle frame (1) through the at least one engaging portion.
6. The combination structure of bicycle frame and motor hub as claimed in claim 5, wherein the positioning groove (111) comprises a rectangular groove, and the at least one engaging portion of the sleeve comprises two parallel engaging surfaces.
7. The combination structure of bicycle frame and motor hub as claimed in any preceding claim, wherein the motor hub includes a stator (22) assembly, a left cover, a right cover, and a plurality of rotor elements (24), and wherein the stator assembly can be engaged with and fixed to the sleeve, and the left cover and the right cover, after having been in alignment with each other, are assembled on the stator assembly.
8. The combination structure of bicycle frame and motor hub as claimed in claim 7, wherein the sleeve (21) of the motor hub is provided, around the whole middle section thereof, with straight slots such that the stator assembly of the motor hub can be engaged with and fixed to the sleeve through the straight slots.
9. The combination structure of bicycle frame and motor hub as claimed in any preceding claim, wherein the elongated axle (3) comprises a hollow axle.
10. The combination structure of bicycle frame and motor hub as claimed in any preceding claim, wherein the head end of the elongated axle (3) comprises an internal hexagonal head.

Patentansprüche

1. Kombinationsstruktur aus Fahrradrahmen und Motornabe, umfassend:

einen Fahrradrahmen (1), beinhaltend eine erste Gabel (11) und eine zweite Gabel (12), die gegenüberliegend angeordnet sind, wobei die erste Gabel (11) mit einem Durchgangsloch (110) bereitgestellt ist, während die zweite Gabel (12) eine Vertiefung mit einem Innengewin-

deloch (121) aufweist, das axial dem Durchgangsloch entspricht, und die erste Gabel (11) an ihrer Innenseite, angrenzend an das Durchgangsloch (110), mit einer Positioniernut (111) bereitgestellt ist;

eine Motornabe (2), die in ihrer Mitte mit einer Muffe (21) bereitgestellt ist, die in Bezug auf ein Positionierende ein Ende aufweist, das dergestalt ist, dass das Positionierende (211) mit der Positioniernut (111) der ersten Gabel eingreifbar und an ihr anschlagbar ist; und

eine längliche Welle (3), die ein vorderes Ende (31) und ein hinteres Ende (32) aufweist, wobei das hintere Ende ein Außengewinde aufweist; die längliche Welle (3) durch das Durchgangsloch (110) der ersten Gabel und die Muffe (21) der Motornabe (2) hindurch gelangen kann, und wobei das Außengewinde des hinteren Endes (32) entsprechend im Innengewindeloch (121) der zweiten Gabel im Eingriff steht und an ihm befestigt ist.

2. Kombinationsstruktur aus Fahrradrahmen und Motornabe nach Anspruch 1, ferner umfassend eine Zahnkranzbaugruppe (4), beinhaltend eine Kupplungsmuffe (41) und ein Schwungradkettenblatt (42), wobei die Kupplungsmuffe koaxial zur Motornabe (2) angeordnet ist und das Schwungradkettenblatt außerhalb der Zahnkranzbaugruppe bereitgestellt ist, sodass das Schwungradkettenblatt synchron mit ihr rotierbar ist, und das Schwungradkettenblatt (42) radial mit mindestens einem Schwungrad bereitgestellt ist.

3. Kombinationsstruktur aus Fahrradrahmen und Motornabe nach Anspruch 2, wobei die Zahnkranzbaugruppe (4) ferner eine Endkappe beinhaltet, die koaxial zur Kupplungsmuffe (41) benachbart angeordnet ist.

4. Kombinationsstruktur aus Fahrradrahmen und Motornabe nach Anspruch 2 oder 3, wobei am Außenumfang der Kupplungsmuffe (41) eine Vielzahl von sich axial erstreckenden Rippen (411) bereitgestellt ist und an der Innenumfangswand des Schwungradkettenblatts (42) eine Vielzahl von Schlitten (421) bereitgestellt ist, sodass das Schwungradkettenblatt und die Kupplungsmuffe synchron so rotieren können, dass die mehreren Schlitten entsprechend mit den mehreren Rippen in Eingriff stehen.

5. Kombinationsstruktur aus Fahrradrahmen und Motornabe nach einem der vorhergehenden Ansprüche, wobei das Positionierende der Muffe (21) mit mindestens einem Eingriffsabschnitt bereitgestellt ist, sodass die Muffe entsprechend an der Positioniernut (111) des Fahrradrahmens (1) durch den mindestens einen Eingriffsabschnitt eingreifbar und

an ihr anschlagbar ist.

6. Kombinationsstruktur aus Fahrradrahmen und Motornabe nach Anspruch 5, wobei die Positioniernut (111) eine rechteckige Nut umfasst und der mindestens eine Eingriffsabschnitt der Muffe zwei parallele Eingriffsflächen umfasst. 5
7. Kombinationsstruktur aus Fahrradrahmen und Motornabe nach einem der vorhergehenden Ansprüche, wobei die Motornabe eine Statorbaugruppe (22), eine linke Abdeckung, eine rechte Abdeckung und eine Vielzahl von Rotorelementen (24) beinhaltet und wobei die Statorbaugruppe in die Muffe eingreifbar und an ihr fixierbar ist, und die linke Abdeckung und die rechte Abdeckung, nachdem sie zueinander ausgerichtet wurden, auf der Statorbaugruppe zusammengesetzt sind. 10
8. Kombinationsstruktur aus Fahrradrahmen und Motornabe nach Anspruch 7, wobei die Muffe (21) der Motornabe um deren gesamten mittleren Abschnitt herum mit geraden Schlitten bereitgestellt ist, sodass die Statorbaugruppe der Motornabe an der Muffe durch die geraden Schlitten eingreifbar und an ihr fixierbar ist. 20 25
9. Kombinationsstruktur aus Fahrradrahmen und Motornabe nach einem der vorhergehenden Ansprüche, wobei die längliche Welle (3) eine hohle Welle umfasst. 30
10. Kombinationsstruktur aus Fahrradrahmen und Motornabe nach einem der vorhergehenden Ansprüche, wobei das vordere Ende der länglichen Welle (3) innen eine hexagonale Vorderseite umfasst. 35

Revendications

1. Structure combinée de cadre de bicyclette et de moyeu à moteur, comprenant : 40

un cadre de bicyclette (1) comprenant une première fourche (11) et une seconde fourche (12) qui sont en disposition opposée, dans laquelle la première fourche (11) est pourvue d'un trou traversant (110), tandis que la seconde fourche (12) est évidée par un trou taraudé (121) correspondant axialement au trou traversant, et la première fourche (11) est pourvue, sur son côté interne adjacent au trou traversant (110), d'une rainure de positionnement (111) ;
un moyeu à moteur (2) qui est pourvu, en son centre, d'un manchon (21) ayant une extrémité, rapportée à une extrémité de positionnement, telle que l'extrémité de positionnement (211) puisse s'engager sur la rainure de positionne-

ment (111) de la première fourche et être bloquée par celle-ci ; et

un axe allongé (3) ayant une extrémité de tête (31) et une extrémité de queue (32), dans laquelle l'extrémité de queue a un filet externe ; l'axe allongé (3) peut passer à travers le trou traversant (110) de la première fourche et le manchon (21) du moyeu à moteur (2), et dans laquelle le filet externe de l'extrémité de queue (32) est engagé de manière correspondante dans le trou taraudé (121) de la seconde fourche et y est fixé.

2. Structure combinée de cadre de bicyclette et de moyeu à moteur selon la revendication 1, comprenant en outre un ensemble à pignons (4) comprenant un manchon de couplage (41) et un disque de chaîne à volant (42), dans laquelle le manchon de couplage est aménagé coaxialement au moyeu à moteur (2) et le disque de chaîne à volant est aménagé à l'extérieur du manchon de couplage de sorte que le disque de chaîne à volant (42) puisse tourner en synchronisme avec celui-ci, et le disque de chaîne à volant est pourvu radialement d'au moins un volant. 15 20
3. Structure combinée de cadre de bicyclette et de moyeu à moteur selon la revendication 2, dans laquelle l'ensemble à pignons (4) comprend en outre un chapeau terminal aménagé coaxialement au voisinage du manchon de couplage (41). 25 30
4. Structure combinée de cadre de bicyclette et de moyeu à moteur selon la revendication 2 ou la revendication 3, dans laquelle une pluralité de nervures axiales (411) sont ménagées sur la circonférence externe du manchon de couplage (41) et une pluralité de fentes (421) sont ménagées sur la paroi circonférentielle interne du disque de chaîne à volant (42) de sorte que le disque de chaîne à volant et le manchon de couplage puissent tourner en synchronisme en sorte que les multiples fentes soient engagées de manière correspondante sur les multiples nervures. 35 40
5. Structure combinée de cadre de bicyclette et de moyeu à moteur selon l'une quelconque des revendications précédentes, dans laquelle l'extrémité de positionnement du manchon (21) est pourvue d'au moins une partie d'engagement de sorte que le manchon puisse être engagé de manière correspondante dans la rainure de positionnement (111) du cadre de bicyclette (1) et bloqué dans celle-ci via la au moins une partie d'engagement. 45 50
6. Structure combinée de cadre de bicyclette et de moyeu à moteur selon la revendication 5, dans laquelle la rainure de positionnement (111) comprend une rainure rectangulaire et la au moins une partie 55

d'engagement du manchon comprend deux surfaces d'engagement parallèles.

7. Structure combinée de cadre de bicyclette et de moyeu à moteur selon l'une quelconque des revendications précédentes, dans laquelle le moyeu à moteur comprend un ensemble statorique (22), une coiffe de gauche, une coiffe de droite et une pluralité d'éléments rotoriques (24), et dans laquelle l'ensemble statorique peut être engagé sur le manchon et y être fixé, tandis que la coiffe de gauche et la coiffe de droite, après avoir été placées dans un alignement mutuel, sont assemblées sur l'ensemble statorique.
8. Structure combinée de cadre de bicyclette et de moyeu à moteur selon la revendication 7, dans laquelle le manchon (21) du moyeu à moteur est pourvu, autour de toute sa section centrale, de fentes droites telles que l'ensemble statorique du moyeu à moteur puisse être engagé sur le manchon et y être fixé à travers les fentes droites.
9. Structure combinée de cadre de bicyclette et de moyeu à moteur selon l'une quelconque des revendications précédentes, dans laquelle l'axe allongé (3) comprend un axe creux.
10. Structure combinée de cadre de bicyclette et de moyeu à moteur selon l'une quelconque des revendications précédentes, dans laquelle l'extrémité de tête de l'axe allongé (3) comprend une tête hexagonale interne.

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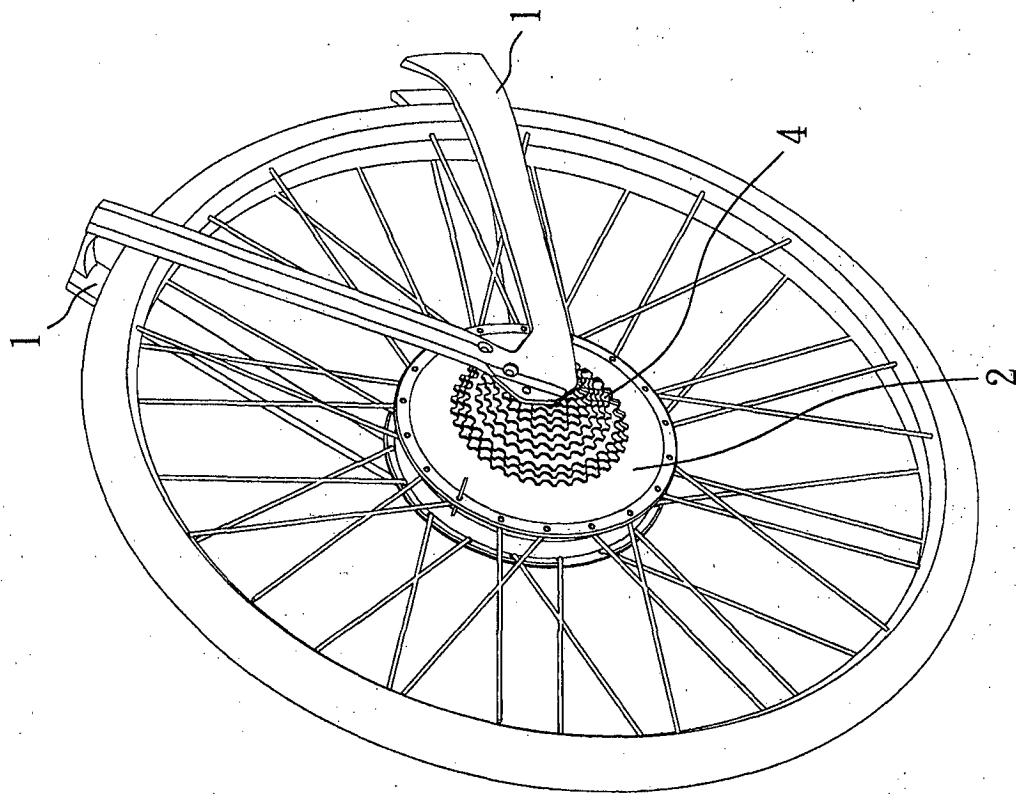


FIG. 1

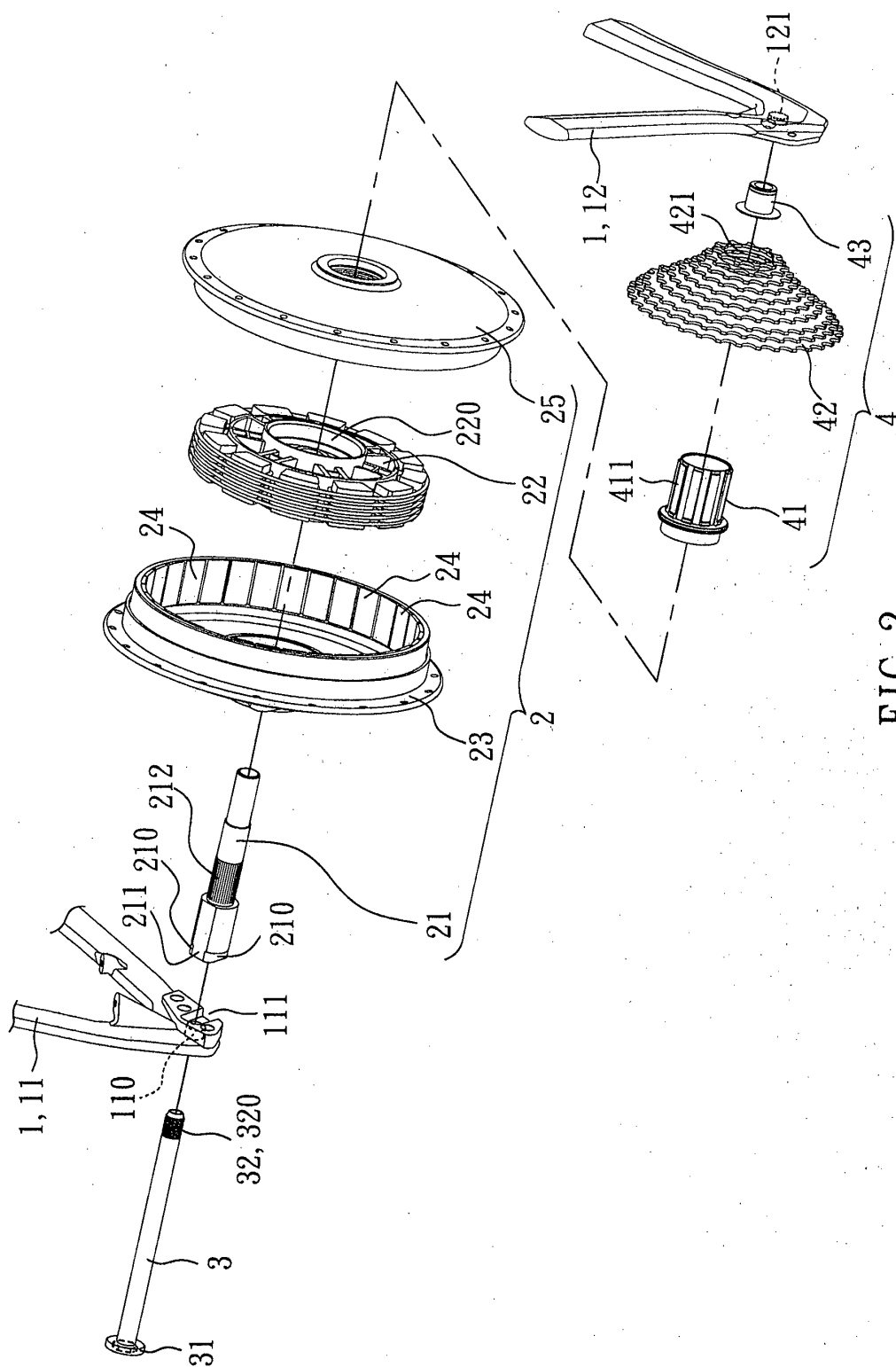


FIG. 2

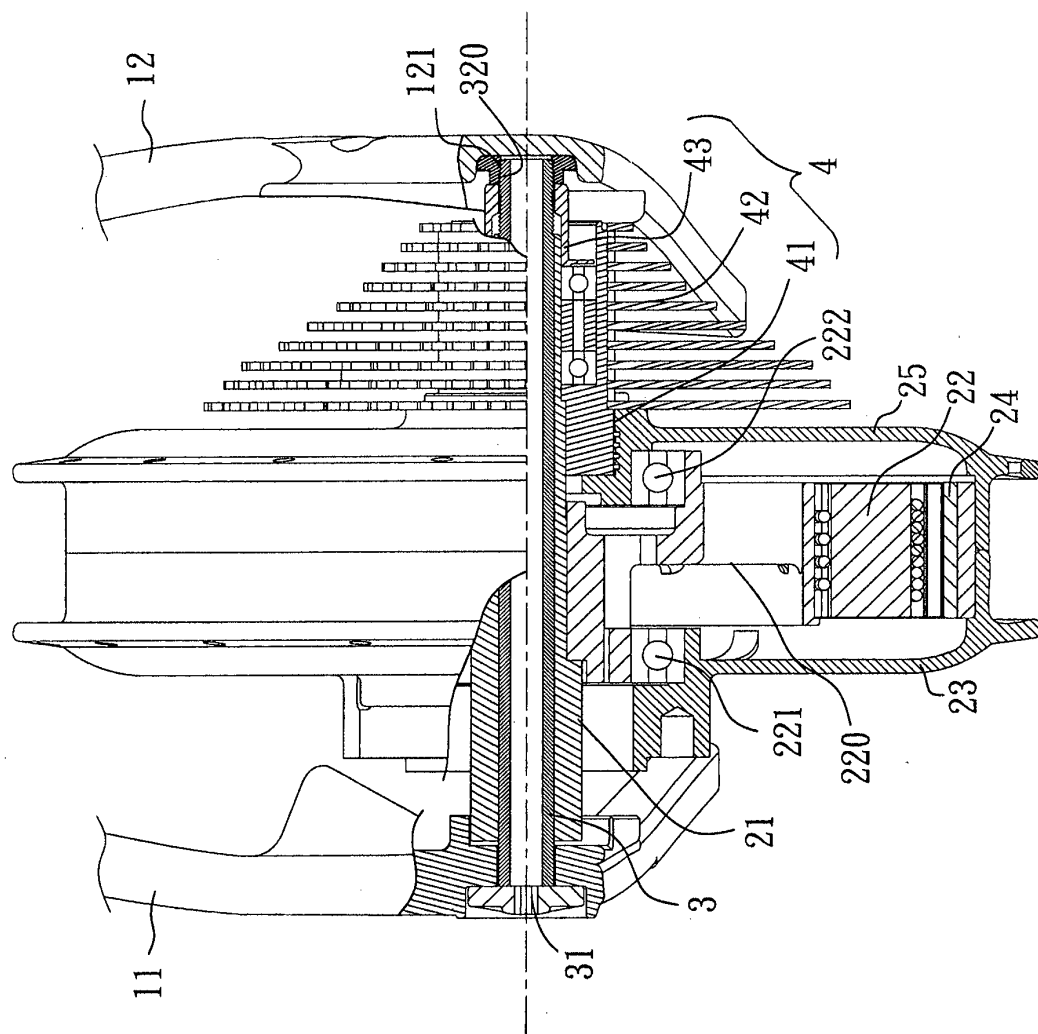


FIG. 3

REFERENCES CITED IN THE DESCRIPTION

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